

Exhibit A

Docket No.: 42390P6785

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Vodrahalli, et al.

Application No.: 09/475,104

Filed: December 30, 1999

For: High Performance Thermal Interface
Curing Process for Organic Flip Chip
Packages

Examiner: Deven M. Collins

Art Group: 2823

AMENDMENT AND RESPONSE TO THE OFFICE ACTION

Assistant Commissioner for Patents
Washington, DC 20231-9998

Sir:

In response to the outstanding Office Action, mailed July 05, 2001, please amend the above-identified Application as follows:

IN THE SPECIFICATION

Please amend the Specification as follows:

Please replace the paragraph beginning at page 6, line 16 with the paragraph below:

As shown in Fig. 2b the thermal element 24 is placed onto the thermal epoxy 22 and the epoxy 22 is cured by a microwave generator 28. The microwave generator 28 generates energy at a microwave frequency that is directed into the thermal epoxy 22. The microwave frequency can be selected to cure the thermal epoxy 22 without damaging the integrated circuit 12 or heating the other components of the package 10. Not heating the other package components eliminates package warpage and epoxy pumping that can create air gaps and

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voids in the integrated circuit/thermal element interface. By way of example, the microwave energy may have a frequency between 1000 and 300,000 megahertz. It is well known that the microwave range exist between 300,000 MHz and 1,000 MHz . After the thermal epoxy 22 is cured, the encapsulant 26 can be formed into the package with an injection mold process. The solder balls 20 can then be attached to the substrate 14 to complete the assembly. It may be desirable to bake the substrate 14 before curing the thermal epoxy 22 to insure that the curing process does not release water from the substrate material.

Please replace the paragraph beginning at page 7 line 9 with the paragraph below:

Although not shown, an alternate method for assembling the thermal epoxy 22 is contemplated. For this alternate method, the epoxy 22 is applied to the thermal element 24 instead of the integrated circuit 12 before being cured by the microwave generator 28.

IN THE CLAIMS

Following is a complete set of claims as amended with this Response. This complete set of claims includes amended claims 10-12, new claims 13-20 and excluding cancelled claims 1-4.

- 1 5. A method for assembling an integrated circuit package, comprising:
2 applying an epoxy to an integrated circuit;
3 placing a thermal element adjacent to the epoxy; and,
4 curing the epoxy with energy at a microwave frequency.
- 1 6. The method of claim 5, further comprising the step of mounting the integrated
2 circuit to a substrate.
- 1 7. The method of claim 6, further comprising the step of attaching a solder ball
2 to the substrate.
- 1 8. The method of claim 5, further comprising the step of molding an encapsulant
2 onto the substrate and the integrated circuit.

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1 9. A method for assembling an integrated circuit package, comprising:
2 applying an epoxy to a thermal element;
3 placing the epoxy and the thermal element onto an integrated circuit; and,
4 curing the epoxy with energy at a microwave frequency.

1 10. (Amended) The method of claim 9, further comprising mounting the
2 integrated circuit to a substrate.

1 11. (Amended) The method of claim 10, further comprising attaching a solder ball
2 to the substrate.

1 12. (Amended) The method of claim 9, further comprising molding an
2 encapsulant onto the substrate and the integrated circuit.

1 13. (New) The method of claim 5, wherein said thermal element is a heat
2 spreader.

1 14. (New) The method of claim 5, wherein prior to applying said epoxy, the
2 method further comprises providing a thermally conductive filler to a resin to form said
3 epoxy.

1 15. (New) The method of claim 14, wherein said thermally conductive filler
2 includes carbon particles.

1 16. (New) The method of claim 5, wherein said placing of said thermal element
2 includes attaching said thermal element to said epoxy.

1 17. (New) The method of claim 5, wherein said curing of the epoxy includes
2 selecting the microwave frequency to cure the epoxy without damaging the integrated
3 circuit or heating other components within the integrated circuit package; and
4 generating energy at the microwave frequency by a microwave generator directed
5 toward the epoxy.

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1 18. (New) The method of claim 9, wherein prior to applying said epoxy to the
2 thermal element, the method further comprises providing a thermally conductive filler to a
3 resin to form said epoxy.

1 19. (New) The method of claim 10 further comprising baking the substrate before
2 curing the epoxy.

1 20. (New) The method of claim 9, wherein said curing of the epoxy includes
2 selecting the microwave frequency to cure the epoxy without damaging the integrated
3 circuit or heating other components within the integrated circuit package; and
4 generating energy at the microwave frequency by a microwave generator directed
5 toward the epoxy.

REMARKS

This Amendment is in response to the Office Action mailed July 05, 2001. In the Office Action, the Examiner rejected (i) claims 5-12 under 35 U.S.C. §102(b). Applicants respectfully traverse the rejection and add claims 13-20. Claims 1-4 have been cancelled without prejudice. Applicants reserve the right to prosecute these claims in the future.

I. SPECIFICATION

Applicants have amended the Specification to correct typographical errors found by the undersigned attorney upon review of the subject application. The text additions do not add any substantive new matters.

Applicants respectfully request that the amendments be entered.

II. REJECTION UNDER 35 U.S.C. § 102(b)

The Examiner rejected claims 5-12 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,981,312 issued to Farquhar, et al. (Farquhar).

Applicants respectfully traverse the rejection because Farquhar does not describe curing the epoxy with energy *at a microwave frequency*. Thus, withdrawal of the § 102(b) rejection is respectfully rejected.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

Please replace the paragraph beginning page 6, line 16 with the paragraph below:

As shown in Fig. 2b the thermal element 24 is placed onto the thermal epoxy 22 and the epoxy 22 is cured by a microwave generator 28. The microwave generator 28 generates energy at a microwave frequency that is directed into the thermal epoxy 22. The microwave frequency can be selected to cure the thermal epoxy 22 without damaging the integrated circuit 12 or heating the other components of the package 10. Not heating the other package components eliminates package warpage and epoxy pumping that can create air gaps and voids in the integrated circuit/thermal element interface. By way of example, the microwave energy may have a frequency between [] and [] 1000 and 300,000 megahertz. It is well known that the microwave range exist between 300,000 MHz and 1,000 MHz. After the thermal epoxy 22 is cured, the encapsulant 26 can be formed into the package with an injection mold process. The solder balls 20 can then be attached to the substrate 14 to complete the assembly. It may be desirable to bake the substrate 14 before curing the thermal epoxy 22 to insure that the curing process does not release water from the substrate material.

Please replace the paragraph beginning page 7, line 9 with the paragraph below:

[Figures 3a and 3b show] Although not shown, an alternate method for assembling the thermal epoxy 22[,] is contemplated. For this alternate method, [wherein] the epoxy 22 is applied to the thermal element 24 instead of the integrated circuit 12 before being cured by the microwave generator 28.

IN THE CLAIMS

1 1. (CANCEL)

1 2. (CANCEL)

1 3. (CANCEL)

1 4. (CANCEL)

1 5. A method for assembling an integrated circuit package, comprising:
2 applying an epoxy to an integrated circuit;
3 placing a thermal element adjacent to the epoxy; and,
4 curing the epoxy with energy at a microwave frequency.

1 6. The method of claim 5, further comprising the step of mounting the integrated
2 circuit to a substrate.

1 7. The method of claim 6, further comprising the step of attaching a solder ball
2 to the substrate.

1 8. The method of claim 5, further comprising the step of molding an encapsulant
2 onto the substrate and the integrated circuit.

1 9. A method for assembling an integrated circuit package, comprising:
2 applying an epoxy to a thermal element;
3 placing the epoxy and the thermal element onto an integrated circuit; and,
4 curing the epoxy with energy at a microwave frequency.

1 10. (Amended) The method of claim 9, further comprising [the step of] mounting
2 the integrated circuit to a substrate.

1 11. (Amended) The method of claim 10, further comprising [the step of] attaching
2 a solder ball to the substrate.

1 12. (Amended) The method of claim 9, further comprising [the step of] molding
2 an encapsulant onto the substrate and the integrated circuit.

1 13. (New) The method of claim 5, wherein said thermal element is a heat
2 spreader.

1 14. (New) The method of claim 5, wherein prior to applying said epoxy, the
2 method further comprises providing a thermally conductive filler to a resin to form said
3 epoxy.

1 15. (New) The method of claim 14, wherein said thermally conductive filler
2 includes carbon particles.

1 16. (New) The method of claim 5, wherein said placing of said thermal element
2 includes attaching said thermal element to said epoxy.

1 17. (New) The method of claim 5, wherein said curing of the epoxy includes
2 selecting the microwave frequency to cure the epoxy without damaging the integrated
3 circuit or heating other components within the integrated circuit package; and
4 generating energy at the microwave frequency by a microwave generator directed
5 toward the epoxy.

1 18. (New) The method of claim 9, wherein prior to applying said epoxy to the
2 thermal element, the method further comprises providing a thermally conductive filler to a
3 resin to form said epoxy.

1 19. (New) The method of claim 10 further comprising baking the substrate before
2 curing the epoxy.

- 1 20. (New) The method of claim 9, wherein said curing of the epoxy includes
2 selecting the microwave frequency to cure the epoxy without damaging the integrated
3 circuit or heating other components within the integrated circuit package; and
4 generating energy at the microwave frequency by a microwave generator directed
5 toward the epoxy.

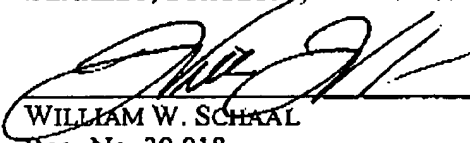
CONCLUSION

In view of the amendments and remarks made above, it is respectfully submitted that all pending claims are in condition for allowance, and such action is respectfully solicited.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

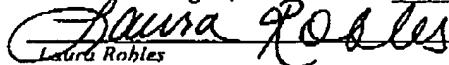
Dated: September 24, 2001


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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on: September 24, 2001.


Laura Robles
Date 9/24/01